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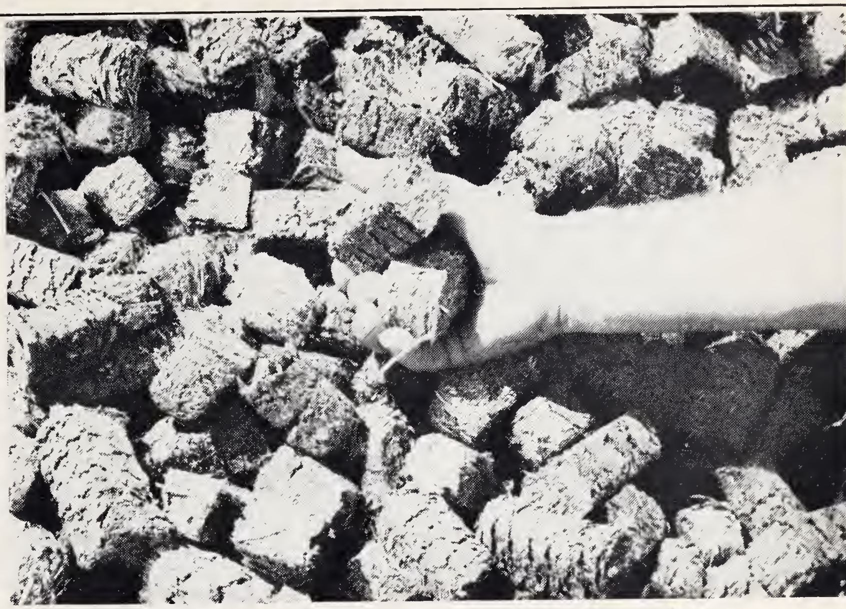
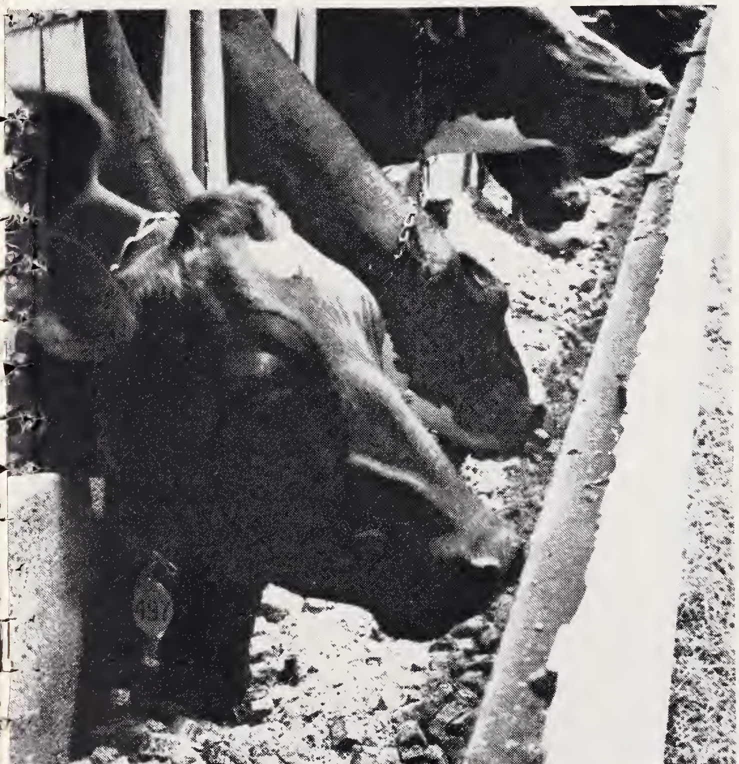


HAY CUBE STORAGE AND FEEDING



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CIRCULAR 550

Hay cubes are dense, bite-sized morsels of hay which are field-produced by machines picking up hay from the windrow, or by stationary machines. Cubes have completely changed handling and feeding methods for alfalfa hay—nearly half a million tons of them are produced annually in California for cattle and sheep, and the figure is growing.

This publication discusses the handling, storage, and feeding methods required for cubes. Numerous illustrations depict the equipment and techniques involved. Design criteria for safe storage are also discussed.

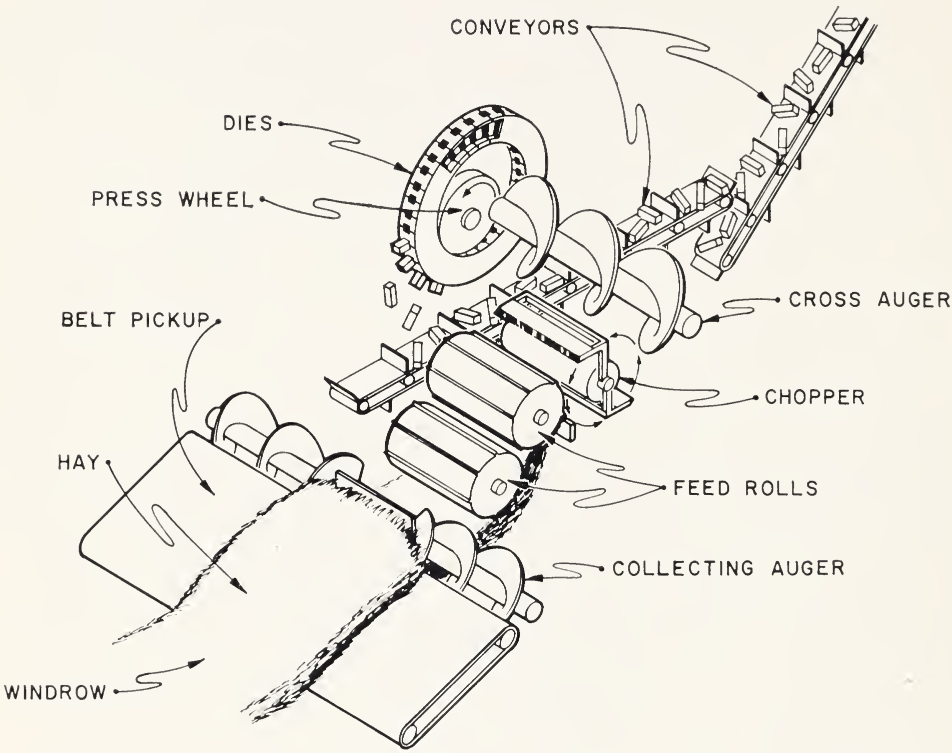

Fig. 1. Principal parts and flow of hay through cuber. Hay is picked up from field, passes under feed rolls, through chopper, is carried by cross-auger to the compression unit, forced through dies by the press wheel, and cubes are then carried by conveyors to a trailer wagon.

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HAY CUBE STORAGE AND FEEDING

Cubed hay has been tested and accepted by livestock feeders in California because of its improved density, better flow and bulk-handling characteristics, reduced storage space, increased feed consumption by animals, and labor savings. Cube-making machines require well-cured hay, obtained from field curing only in arid irrigated regions such as the Central Valley of California; cubing with available machines is mainly limited to alfalfa. The quality and density of cubes are reduced if more than 10 per cent of grass or other foreign material is present, or if the alfalfa is too mature.

In 1969, the only cube-making machines available commercially are of the roller-die principle (fig. 1), which involves extruding forage through a circle of dies, using a roller for compressing the hay into cubes (the hay is chopped before it enters the compression chamber).

Cube size and shape. Many sizes and shapes of cubes have been produced by various experimental machines, but cubes now available commercially are 1¼ inches square and vary from 1 to 4 inches in length. This size allows optimum feeding, has acceptable materials-handling characteristics, and can be produced at reasonable capacity with a farm-size power unit.

Moisture content. Alfalfa hay should be cured to about 10 per cent moisture content before cubing. Water is sprayed on the windrow of hay as it enters the cubing machine, resulting in warm cubes at 14 to 16 per cent moisture as they emerge from the machine. For safe storage, cubes should be cooled and dried by natural or forced aeration to 14 per cent or less moisture content. Excess moisture and heat in stored cubes causes mold growth, loss of quality and nutrients, and can result in loss of crop by fire.

Density and volume. Density of cubed hay varies with moisture content, quality, and maturity of hay. Good quality cubes will be close to 30 pounds per cubic foot bulk density as they emerge from the machine. After cooling, natural drying, and handling, cubes will average about 25 pounds per cubic foot and require 80 cubic feet per ton for storage—this compares to about 10 pounds per cubic foot for baled hay when closely stacked, or 200 cubic feet per ton.

Fines. Fines or trash (leaves, stems and chips of cubes) are not desirable in cubed hay, mainly because they adversely affect handling and storage, and can reduce feeding efficiency. A reasonable amount of fines (up to 10 per cent by weight) is usually acceptable (see discussion below).

PRODUCTION, HANDLING, AND STORAGE

Cubes are hot (120° to 140° F) as they emerge from the dies on the machine and are conveyed into a bin having a capacity of up to 4 tons. The filled bin is dumped into a transport truck of 6 to 25 tons capacity which, when fully loaded, is driven to the producer's storage. Elapsed time from forming the cubes to storage will average about 1 hour, during which time the average temperature of the load may drop about 20°F. If cubes are elevated directly into a storage building and piled up to 25 feet deep, a great deal of residual heat may be trapped in the pile. With normal conveying equipment (screw, belt, or chain), cubes will be dropped into a cone-like pile with the fines accumulated at the center. The fines impede natural air flow and make it difficult for residual heat to dissipate, so it is common practice to dump cubes on a concrete slab in shallow piles (fig. 2) and allow them to cool 12 to 24 hours before being deep-piled in storage. In desert areas where cover is not provided, cubes are sometimes stacked in deep piles directly from the cuber, and natural aeration is depended upon to remove residual heat from piles.

Fig. 2. Cubes are dumped 3 to 4 feet deep on slab to permit cooling and hardening before being handled by conveyor or placing in deeper piles. Proper cooling of cubes is essential.

Large storage structures are filled by various combinations of mechanical elevators and conveyors. Where space permits, a relatively inexpensive chain and flight conveyor elevating at about a 45 degree angle will do an excellent job of moving cubes to the maximum height; conveyor capacity should be about ½ ton per minute to minimize unloading time for the truck. If space is limited, a below-grade dump pit may be used, and a screw-fed bucket elevator used to raise cubes to the horizontal distribution conveyor. Such an arrangement may cost two to three times as much as the chain and flight elevator.

A horizontal conveyor suspended under the peak of the roof distributes cubes the length of the storage structure. Screw, belt, cable and flight, or chain and flight conveyors are all satisfactory provided conveyor size and speed are adequate (table 1).

TABLE 1

SPECIFICATIONS FOR CUBE CONVEYORS

Type of conveyor	Minimum width or diameter	Recommended speed	Capacity	Method of removal	Horsepower required for 200-foot conveyor
	inches		*tons per min.*		
Screw	16	70 rpm	0.5	Drop-through holes	5.0
Troughed belt	16	300 fpm	0.5	Tripper	2.0
Flat belt	20	400 fpm	0.5	Diagonal scraper	12.0
Cable and flight	16	100 fpm	0.5	Drop-through holes	5.0
Chain and flight	16	100 fpm	0.5	Drop-through holes	5.0

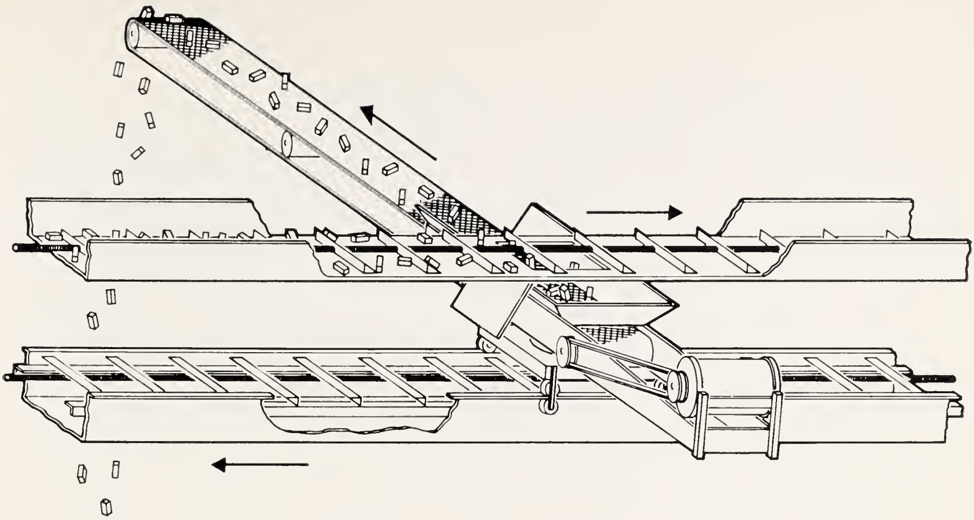


Fig. 3. Cable and flight transport conveyor wtih belt cross-conveyor. The transport conveyor runs the length of the storage structure, with drop-through holes every 8 to 10 feet in the upper conveyor. The cross-conveyor is carried on the frame of the return of the transport conveyor, and is swivelled to deliver in any direction. The cable is driven over auto wheel, as shown in figure 13.

Flight or screw conveyors are commonly used for distribution, partly because of the ease of unloading through openings in the floor of the conveyor. These square drop-through holes are the width of the conveyor floor and are spaced 8 to 10 feet apart. The conveyor deposits a ridge of cubes the length of the storage structure, with an angle of repose of about 45 degrees. A storage structure with cross-sectional dimensions proportioned as shown on page 6 provides maximum utilization of storage space without a cross-conveyor or spreader. Fines or trash in cubed hay tend to be concentrated directly under the delivery points of the conveyor system, since clean cubes tend to roll to the outside.

A cross-conveyor (fig. 3) will carry cubes to a greater number of delivery points, thus spreading the total amount of fines over a greater area. While this is helpful if the conveyor is moved frequently, it still permits undesirable concentration of fines under each delivery point (fig. 4) thus providing suitable conditions for hot spots.

A spinner-type spreader (fig. 5) will provide more uniform piling in storage but the fines are not thrown as far as the cubes, with the result that fines are spread over a space about 12 feet wide for the length of the storage area. The spinner can spread a thin layer of cubes over a large area so that they can cool before residual heat becomes trapped in the pile; the spinner also permits more efficient use of storage space in a flat-roofed building. A 4-foot diameter spinner operated at 125 rpm will throw 1¼ inch cubes 15 to 18 feet horizontally (this is suitable, for example, for filling a 70-foot wide storage shed having a 4-in-12 roof slope).

Driving vehicles on stored cubes will crush the cubes; this creates excessive fines and packs them, thus reducing normal air circulation. Cubes should never be mechanically packed into deep storage.

Storage structures for cubed hay should have smooth solid floors, rainproof roofs, and rain-tight sidewalls or sufficient roof overhang to prevent rain from blowing in. Smooth concrete floor is most satisfactory for easy removal of cubes by power scoop; for this type of handling, sidewalls should be reinforced concrete 4 to 6 feet up from the floor with metal or wood sidewalls up to the maximum piling depth at the wall. Sidewalls should have ample strength to withstand the lateral pressure

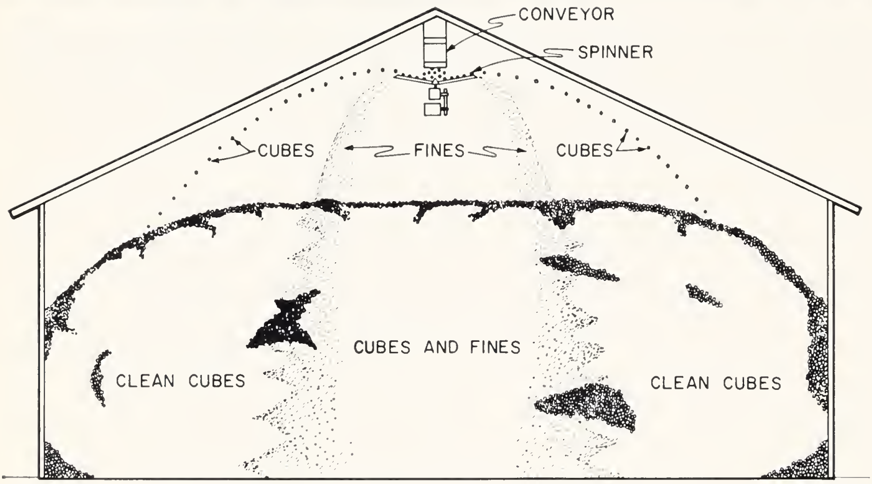


Fig. 4 (top). Pile of cubes resulting from cross-conveyor piling, showing aeration duct (bottom) projecting from cubes.

Fig. 5 (middle). Spinner-type cube spreader. Note approximate trajectory of fines and cubes.

Fig. 6 (right). Cross-section of building providing maximum utilization of space for cube storage with single distribution conveyor.

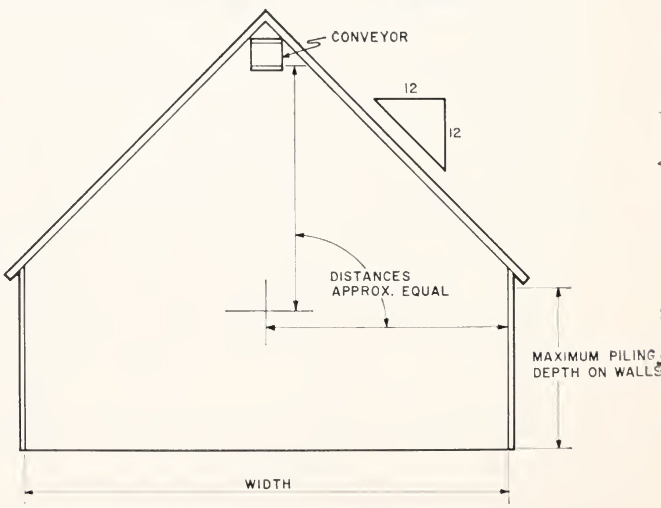


Table 2

SPECIFICATIONS FOR FLAT WALLS FOR HAY CUBE STORAGE

Lumber—construction grade or better

Wall height (feet)	Stud spacing—center to center				Pole spacing*	
	12 inches	16 inches	24 inches	48 inches	8 feet	12 feet
0 to 8	2″ × 4″ studs ¾″ siding or ⅜″ plywood	2″ × 4″ studs ¾″ siding or ⅜″ plywood	2″ × 6″ studs ¾″ siding or ½″ plywood	2″ × 8″ studs 1″ siding or ¾″ plywood	5″ diameter poles 2″ siding	6″ diameter poles 3″ siding
8 to 12	2″ × 6″ studs ¾″ siding or ⅜″ plywood	2″ × 8″ studs ¾″ siding or ⅜″ plywood	2″ × 8″ studs ¾″ siding or ½″ plywood	4″ × 8″ studs 1″ siding or 1″ plywood	7″ diameter poles 2″ siding	8″ diameter poles 3″ siding
12 to 16	2″ × 8″ studs ¾″ siding or ⅜″ plywood	3″ × 8″ studs ¾″ siding or ⅜″ plywood	4″ × 8″ studs ¾″ siding or ½″ plywood	8″ × 8″ studs 1″ siding or 1¼″ plywood	8″ diameter poles 3″ siding	9″ diameter poles 4″ siding
16 to 20	4″ × 8″ studs ¾″ siding or ⅜″ plywood	6″ × 8″ studs ¾″ siding or ⅜″ plywood	5″ × 10″ studs ¾″ siding or ⅝″ plywood	10″ × 10″ studs 1½″ siding	10″ diameter poles 3″ siding	11″ diameter poles 4″ siding

Wall height (feet)	Anchor bolts for wall studs shown above†												Bolts or lag screws					
	Size	Number		Size	Number		Size	Number		Size	Number		Size	Number		Size	Number	
		Top	Bottom		Top	Bottom		Top	Bottom		Top	Bottom		Top	Bottom		Top	Bottom
0 to 8	½″	1	2	½″	1	2	½″	2	3	¾″	3	6	¾″	3	..	1″	3	..
8 to 12	½″	2	4	½″	2	4	½″	3	5	1″	2	4	1″	3	..	1″	4	..
12 to 16	½″	3	5	¾″	2	3	1″	2	3	1″	2	3	1″	4	..	1″	5	..
16 to 20	½″	2	4	¾″	2	4	1″	2	4	1″	2	4	1″	4	..	1″	5	..

* Poles are round and tapered; diameters are measured at the middle.
† See figure 7.

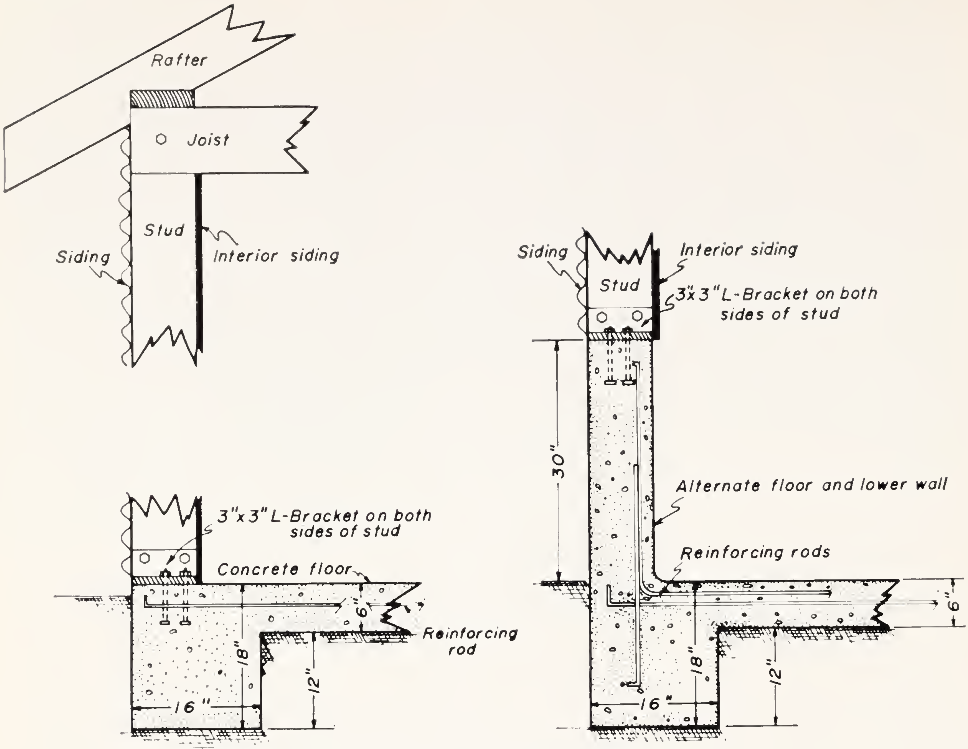


Fig. 7. Typical wall construction.

of cubes. Wire mesh can be used near the top of the wall where lateral pressure is minimal, thus increasing ventilation in the building. Table 2 shows the structural sizes of wood sidewalls recommended for safe design. Figure 7 shows typical wall construction.

Cubed hay stored in deep piles exerts a lateral pressure up to about 9 pounds per square foot per foot of depth on the sidewalls. Therefore inside wall sheathing is required, and buildings should have adequate stud or post anchoring at the base plus horizontal ties at plate level. The wall design in figure 7 includes an alternate lower wall of concrete to protect against damage from tractor scoops. Side walls of old buildings should be inspected; if deficient in strength requirements they should be reinforced in accordance with table 2. Care must be taken when cable is used to tie together opposite side walls of a storage building. If the cable becomes buried in a pile of cubes, excessive inward loads may be placed on the walls due to settling of the cubes.

Aeration. Cubes can be piled directly in deep storage and cooled by forced air from fans. An aeration rate of 0.1 cubic foot of air per minute per cubic foot of storage is satisfactory for 1¼-inch cubes; for this air rate at depths of up to 50 feet the static pressure requirement is approximately 0.01 inch of water pressure per foot of depth. A 2-hp fan capable of delivering 8000 cfm (cubic feet per minute) at ¼ inch of water will do an adequate job of cooling 1000 tons of hay cubes when stored at depths up to 25 feet. Center-to-center spacing of ducts should not exceed 1.5 times the maximum depth of cubes in order to provide uniform air distribution. The velocity of air in these ducts should not exceed 1,000 feet per minute, using the relationship:

$$\text{velocity} = \frac{\text{air rate in the duct (cfm)}}{\text{duct cross-sectional area (sq. ft.).}}$$

Two major problems reduce the practicality of artificial aeration of cubed hay:

• The duct system is a major impediment to the removal of cubes by motor

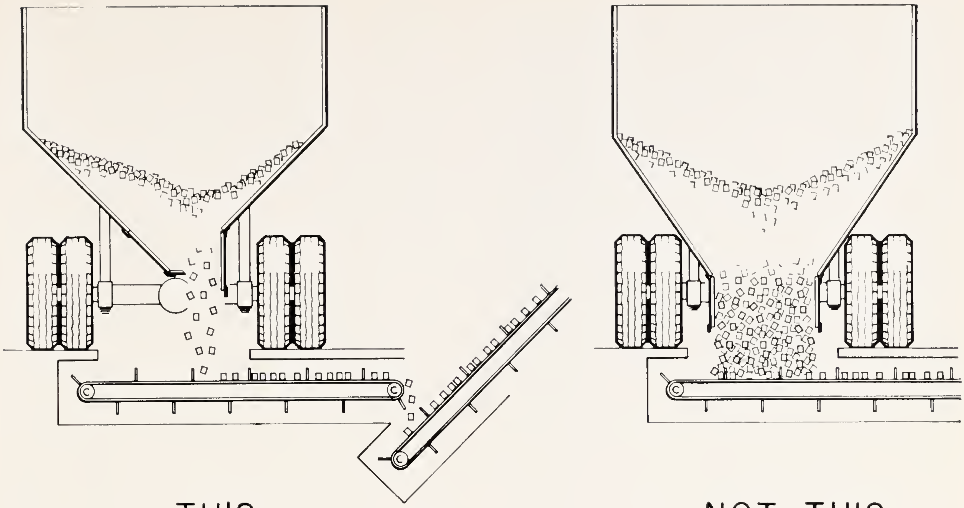


Fig. 8. To reduce damage, cubes should flow from truck without overloading conveyor.

scoop. An above-floor system limits movement of the scoop, and underfloor ducts constructed to support this heavy equipment would be costly and less efficient for air distribution.

• Uniform piling of cubes over the aeration system is usually incompatible with field production, and with the cube-distribution system used to fill, and remove cubes from, storage areas.

Thus, while aeration with fans is inexpensive and effective, it has been poorly accepted in practice because of the abovementioned problems. Fan aeration can be provided for a few cents less per ton than the standard method of cooling on the slab, including the additional handling from slab to storage.

Transporting wafers. Cubed hay is transported in bulk in hopper-bottom trucks and trailers similar to grain transport units. Handling in smaller bulk units, usually about 1-ton capacity, has been tried with some of the larger wafer-shaped products, but 1¼-inch cubes flow well from the larger containers. Normal payload for a truck and trailer is 25 tons.

Transport units are loaded with large power scoops, usually requiring 20 to 30 minutes per 25-ton load. At the delivery point the truck is driven over a pit, or a low-profile conveyor is slipped under the truck, and cubes flow by gravity from the truck hopper. Elevator and conveyor systems used to load the consumer's storage are similar to those already described. Conveyors should be capable of unloading a 25-ton load in an hour. Cubes delivered to the consumer have usually had ample cooling and drying time, so that a mechanism for spreading the cubes is not needed. (Also, feeder's storage space is usually long and narrow, so that a single conveyor down the center will fill the storage space.)

Feeder's storage. The design of the feeder's storage should provide for:

Easy transferring of cubes from transport to storage. Part of the reduced cost of transport of cubed hay is due to the saving in time and manpower required to unload as compared to baled hay. The standard unloading method is to drive trucks over a below-ground conveyor and let cubes flow into the conveyor by gravity. Cubes are released through sliding gates in the hopper bottom, preferably arranged so the cubes flow onto the conveyor rather than having the conveyor drag them off the bottom of the load (fig. 8). A portable chain and flight elevator, with hopper below the ground level, works well. An auger-fed bucket elevator is more expensive and may cause excessive fines

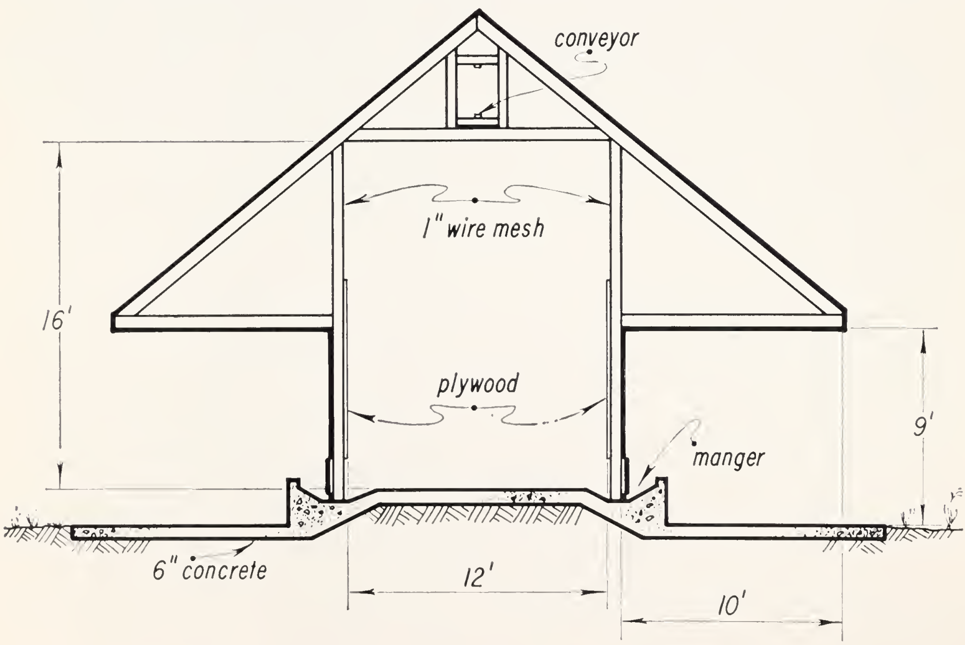
where cubes are transferred from auger to buckets, unless carefully designed so the auger doesn't overfeed the elevator. The elevator drops the cubes onto a horizontal distribution conveyor located above the storage area.

Rain-tight storage structure. Excessive moisture tends to make cubes expand and disintegrate into individual particles or fines, and can cause molding, spoilage, heating, and spontaneous combustion. Thus, it is important that stored cubes be protected from rain or excess moisture from any source other than natural humidity in the air. Serious spoilage and spontaneous combustion have occured where an appreciable amount of water has been deposited on cubes from a roof leak or from the roof drip-line. During high humidity or fog the surface of a pile of cubes will absorb moisture and may, when weather conditions persist, disintegrate into fines. This situation normally causes no serious spoilage nor heating problems, as it occurs only on the surface of the pile—mold formation is no more serious here than on any other hay stored in the same climate.

Easy removal of cubes for feeding. The method of feeding may determine the size, shape, and accessibility requirements of cube storage. If a self-feeding system is planned, the storage area should be long and narrow with minimal requirements for operating tractors or scoops. For conveyor feeding, cubes may be removed from the center rather than along the sides. For wagon feeding, a large door is needed for loading wagons by tractor-mounted scoop. Thus, the feeding method should be decided before any new storage area is designed or constructed.

FEEDING CUBED HAY

Cubes have several advantages which allow dairymen to feed them profitably in spite of their higher delivered price. They require less storage space, and the labor and equipment needed for feeding are less than for baled hay. There is much less waste with cubes, and cows will eat more hay in cubed form, thus reducing the amount of higher-priced grain and concentrate required. Cube feeding elimi-



nates the unsightly piles of bales and bale ties and generally improves the appearance of the dairy. Hardware disease can, however, be aggravated if cubes are produced from wire-infested fields. Dairymen experienced in feeding cubes prefer them to bales, particularly as a means of reducing drudge labor. Three basic methods are used for feeding cubed hay to dairy animals: self feeding, conveyor feeding, and wagon feeding.

Self-feeding barns. This is the most common and usually the least expensive means of feeding dairy animals, mainly because storage and feeding are combined in one structure and little equipment or labor is needed. The storage structure is built with approximately the cross section shown in figure 9, using the design data of table 2. Hay is stored in the center section, which is 11 to 16 feet wide and up to 20 feet high. Feed bunks are located along each side; about 2 feet of feed bunk per cow is provided.

Self-feeding barns are dependent on gravity-flow characteristics of the feed and are well suited to 1¼ inch or smaller cubes. Large, flat wafers would not be adaptable to this system, but cubes gravitate toward feed bunks with a minimum of manual assistance as long as the sloping surface of the stored pile is above the bottom of the manger. Below this level manual or mechanical movement is required for feeding. Because fines tend to accumulate directly under the storage filling conveyor (fig. 10), the problem of moving the last feed to the feed manger may be increased.

Another variation of the self-feeding barn includes an A-frame floor down the center (fig. 11) to eliminate that part of storage requiring considerable labor for feeding. This design has received limited use because of the loss of storage space. The extra supply of feed available in this space need not be fed out for each filling.

Accumulation of fines in the manger is a management problem. Animals prefer cubes to fines, and will push the fines aside to obtain a cube. Self-feeding provides a steady supply of cubes, so that some method of controlling cube availability is desirable to minimize wasted feed. The feed manger can be designed so that the animals must eat most of the fines before they can reach more cubes. Figure 12 shows a recommended manger design. Some dairymen prefer to use sliding gates as a means of cutting off the supply of cubes until the fines are consumed.

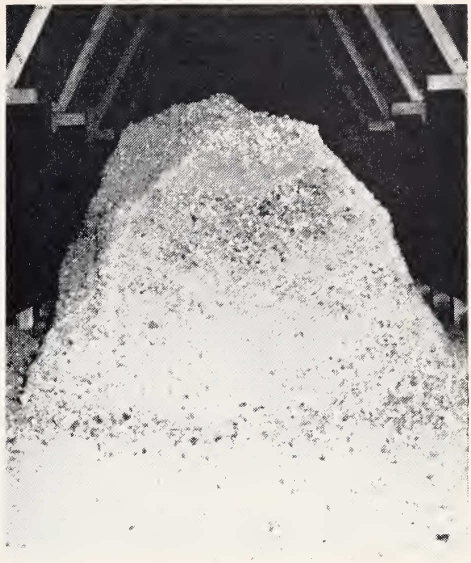


Fig. 10. Fines may accumulate under the distribution conveyor, increasing the problem of moving this part of the hay to the mangers.

Self-feeding barns provide a constantly available feed supply. If hay quality is non-uniform, the animals may select the better hay, leaving that which is less palatable. Control of the amount fed per day requires some system of limiting the time during which cows have access to the mangers. This may be provided by fencing, or by covering the mangers. The latter method can be accomplished by time-clock controlled mechanical covers.

Mechanical conveyor feeding. Cubes may be conveyed from storage to the animals by a mechanical feeding system. A supply conveyor is located below floor level through the center of the storage area

Fig. 9 (left). Recommended cross-section dimension of self-feeding barn for dairy cows. Note roof overhang and concrete slab for protection of animals. To provide air circulation through wire mesh and upper part of storage, roof overhang is not closed in.

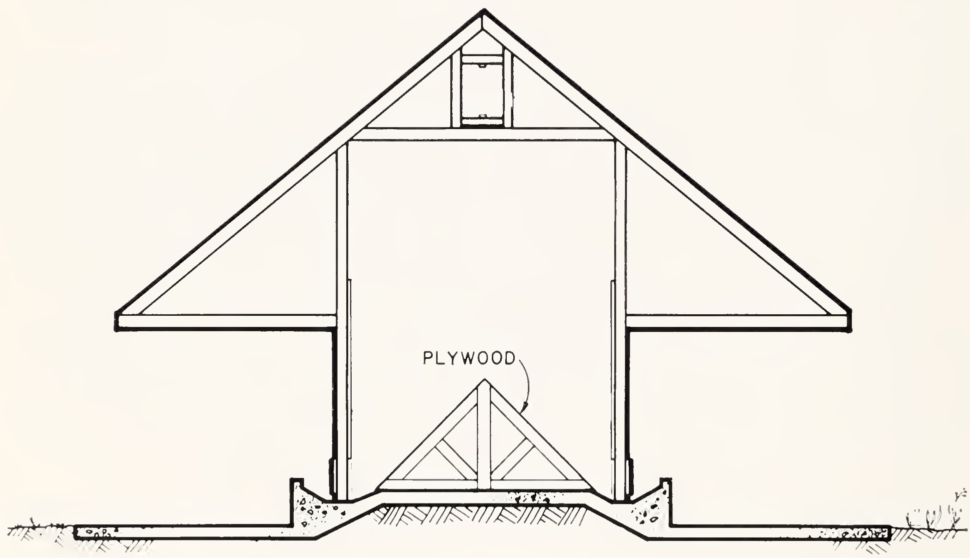
to carry cubes to feed bunks located outside the storage area. Several types of conveyors may be used to distribute the feed along the feed bunk, usually in a prescribed amount per foot of feed bunk. Chain-and-flight, cable-and-flight, screw, or belt conveyors may all be adapted for this purpose. With either type of flight conveyor, flights may be shaped to deliver feed to one or both sides of the feed bunk (fig. 13). A belt conveyor may also be used as a feed table, or a travelling scraper may move along the length of a conveyor belt to transfer the cubes to the feeding area of the manger. Several different designs of auger feeders, available commercially, are adaptable to cube feeding provided a 9-inch or larger screw is used.

Conveyor feeding takes a man about 1 minute for every 10 cows for each feeding. Since the man is normally supervising loading of the transport conveyor out of sight of the feeder, he cannot see when the manger is filled. The operation can be timed so the man knows how long the conveyor must be operated, or a system can be installed to signal the operator or turn off the conveyor when the manger is filled.

Conveyor feeding provides easy control of accumulation of fines. If a buildup of fines occurs, the amount fed can be reduced to match animal intake.

Conveyor feeding costs about twice as much as self-feeding, due to a slight increase in labor and an appreciably greater equipment cost. Cost of operating conveyors is minimal.

Wagon feeding. Cubes may be loaded from storage into a wagon or truck which delivers the feed to the feedbunk (fig. 14). A tractor-mounted scoop is normally used to load the feed wagon with up to 2 tons



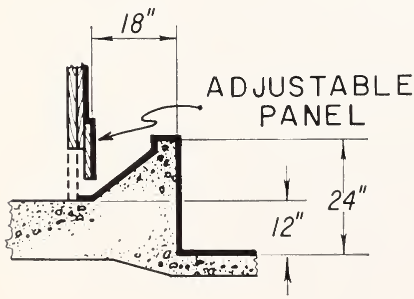


Fig. 11 (above). Alternate barn-floor design to eliminate handling cubes in lower part of storage. Note reduction in storage space.

Fig. 12 (left). Recommended manger cross-section for a self-feeding cube barn. Sloping bottom reduces buildup of fines in the manger. Adjustable panel may be lowered to stop or control flow of cubes and force animals to eat fines.

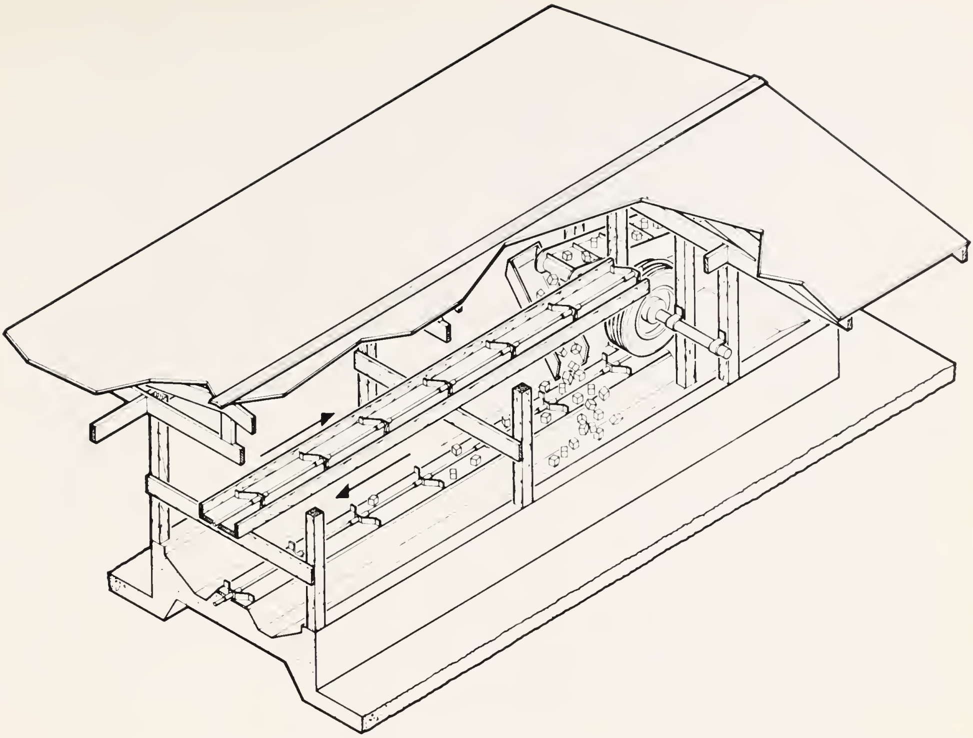


Fig. 13. Cable-and-flight cube feeder for livestock. Cubes are carried on lower run of conveyor. Flights are shaped to push cubes to side. When manger is full, cubes carry along and fall into empty manger. The auto tire is partly inflated so that the cable runs in a groove.

of cubes. Cubes can be stored in overhead bins from which the wagon can be loaded by gravity. A cross-conveyor on one end of the wagon distributes feed to the feed bunk as the wagon moves along. This equipment is often available on dairy farms, and can easily and relatively cheaply be adapted to cubed hay. It is the simplest and least expensive method of feeding cubes on a trial basis, particularly when equipment is already available. Labor costs are higher than for conveyor feeding, but when overhead and operating expenses for equipment are added the total cost is comparable to that of conveyor feeding.

Wagon feeding is adaptable to large or widespread operations and to any terrain, and is increasing in popularity for large dairies. Dry stock can be fed separately with the same equipment in dairy operations. The amount fed can be controlled to minimize waste and accumulation of fines. Wagon feeding is readily adaptable to cattle and sheep feeding.

Portable self-feeders. Self-feeders capable of storing up to a week's supply of cubes merit serious consideration for some feeding operations. In the interest of over-all system economy, consumers might well consider subsidizing producers' storage in order to eliminate or reduce their own storage. Thus, where accessibility of supply permits, daily or weekly delivery of cubes from the hay producer directly to the consumer's self feeders may reduce over-all cost. Such a system shifts most of the cost of storage to the hay producer, or to some intermediate storage and delivery operation.

Figure 15 shows a recommended design for a portable self-feeder. The capacity of this feeder in 8-foot lengths is about 2 tons. Allowing 1 foot of feeding space per cow, this would have ample capacity for 16 milking cows for 1 week.

Fig. 14 Feed truck unloading cubed hay into a feed bunk.

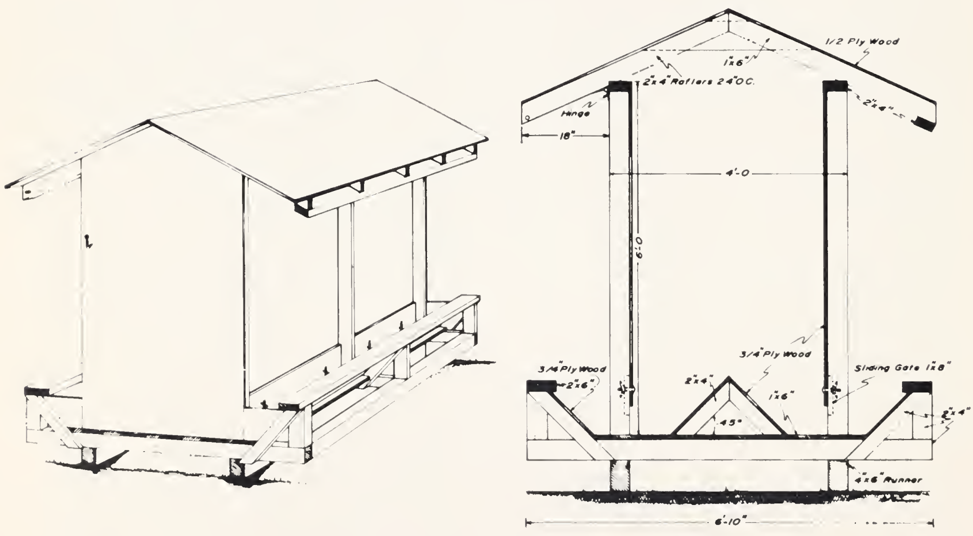


Fig. 15. Portable self-feeder for cubed hay. An alternate design, Form 52-500, is available from the American Plywood Association, 1119 A Street, Tacoma, Washington 98401.

Feeders should be located so they can be easily filled by highway transport from all-weather roads. Minimum drive width should be 15 feet, with no curbs on inside curves, and a minimum center line radius of 40 feet on curves. Self-feeders can, of course, be filled from the consumer's storage as well; this can be done by tractor scoop or by a truck-mounted conveyor. Self-feeder design modifications for smaller animals, such as sheep or calves, may be necessary to minimize waste.

FEEDING CUBED HAY TO BEEF CATTLE

Cubed hay may be fed in whole form to growing cattle, or may be fed crushed or ground as an ingredient in mixed rations for fattening. Various reports have shown increased gains where whole cubes have been fed, primarily due to increased feed consumption.

Feeding methods for whole cubes are similar to those discussed for dairy cows. The wagon method of distribution is the most common, as most beef feeding layouts are too widespread for efficient use of mechanical conveyors. Self-feeding barns and small self-feeders can also be efficient methods for feeding whole cubes to growing cattle.

Cattle require grain and concentrate as a major portion of their fattening ration. It is common practice to break up the cubes and mix them with grain to provide a single complete ration. Cubes will mix and feed reasonably well without breaking, but most feeders feel that this permits selectivity by the individual animal, so that cows do not necessarily eat the balanced fattening ration.

Cubed hay should not be ground too finely for cattle feeding. Some cattlemen use baled-hay hammermill equipment for grinding, but eliminate the bale-breaker and, usually, the grinder screen. Normally, all that is necessary is to retain cubes in the hammermill chamber long enough to assure that each cube will be struck and broken. Depending on the hammermill design, a coarse screen or breaker bar may be required. Some equipment manufacturers are now making small simplified hammermills for cubes.

Roller-type crushers have also been developed for shredding or breaking cubes. This or the hammermill system works well, and each requires only a fraction of the power used for grinding baled hay. The increased capacity and reduced power for grinding, and the transport and labor saving in handling, are the principal advantages of cubes over bales for fattening rations. Broken cubes can be introduced as the hay ingredient in any feed-mixing plant. Figures 16 and 17 show schematically two simple mixing operations now in use. The method of feeding the fattening ration is not affected by replacing baled hay with cubes.

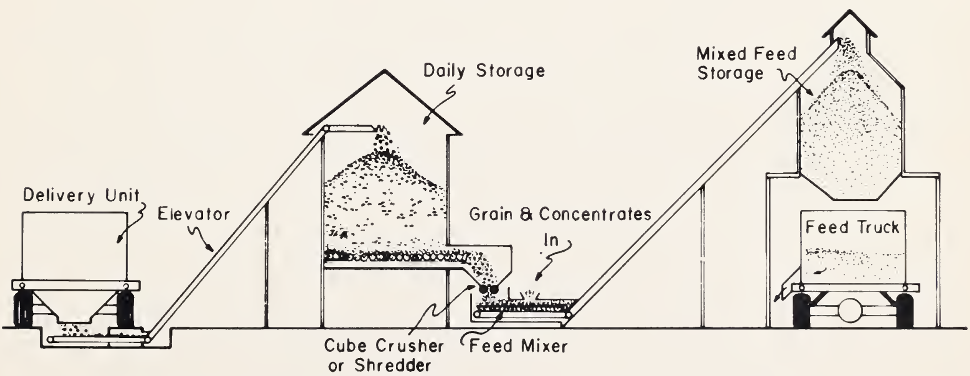


Fig. 16. Feed-mixing plant receiving daily delivery of cubes from supplier. Cubes are elevated into storage, conveyed to a crusher or shredder, and then fall into mixer. Other feed ingredients are combined in the mixer and then conveyed to storage or directly to the feed wagon.

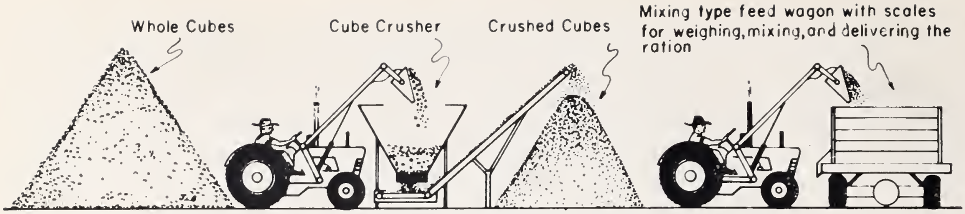


Fig. 17. Feedlot system, with large cube storage. Cubes are transferred to crusher by scoop, and a stockpile of crushed cubes is maintained. Same scoop is used to load mixing feed wagon.

FEEDING CUBED HAY TO SHEEP

Limited experience in feeding 1¼-inch cubes indicates that ewes, bucks, and even weaned lambs can handle them satisfactorily after a 4- or 5-day training period. Ewes wintered on cubed hay are reported to come through the lambing period in excellent condition, and may even gain weight unless limited in hay intake. Some waste is experienced because sheep must break a 1¼-inch cube in order to eat it.

Methods for feeding cubes to sheep are not well established. Supplemental range feeding has been accomplished by dropping cubes on the ground from a wagon or truck, but this causes more waste than when fed in sheep-height feed bunks. The recommended method requires controlled filling of feed bunks from a side-delivery wagon, or use of small self-feeders of the type shown in figure 15. Sheepmen are cautioned to expect some waste of cubes due to dropping on the ground, particularly the first few days. After the training period, the waste is much less than there would be in using long hay.

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